

CLAIMS

WHAT IS CLAIMED IS:

1. A method for making a holder/optical-element assembly, comprising the steps of:
 - positioning a cylindrical holder material in a press-molding die, the holder material having a void part in an inner circumferential surface;
 - positioning an optical-element material inside the cylindrical holder material;
 - heating the cylindrical holder material and the optical-element material to their own softening temperature; and
 - press-molding the cylindrical holder material and the optical-element material to form a cylindrical holder and an optical element, respectively, thereby fixing the optical element to the inner circumferential surface, allowing a projected portion of the optical element formed by pressure created during press-molding to extend outwardly from an outer edge, and retaining the projected portion in the void part of the holder.
2. A method for making a holder/optical-element assembly according to Claim 1, wherein the pressure created during press-molding allows a part of the optical element to flow into the void part of the holder to form the projected portion of the optical element.
3. A method for making a holder/optical-element assembly according to Claim 1 further comprising forming reference surfaces in an outer surface of the cylindrical holder by press-molding the cylindrical holder material for mounting the holder/optical-element assembly along an optical axis and in a radial direction.
4. A method for making a holder/optical-element assembly according to Claim 1 further comprising adding an extra amount of the optical-element material, in advance, to the volume required for forming the optical element,

wherein pressure created during press-molding allows the extra amount to flow into the void part of the holder to form the projected portion of the optical element.

5. A method for making a holder/optical-element assembly according to Claim 1, wherein the holder material comprises a cavity in the inner circumferential surface for retaining the projected portion of the optical element.

6. A method for making a holder/optical-element assembly according to Claim 1, wherein the holder material comprises a plurality of micro-pores in the void part for retaining the projected portion of the optical element.

7. A method for making a holder/optical-element assembly according to Claim 1, wherein the holder material has a plurality of the micro-pores on a part of the inner circumferential surface, the pores included in a void part for retaining the projected portion of the optical element.

8. A method for making a holder/optical-element assembly according to Claim 5, wherein the cavity comprises one or more concentric cavities in the inner circumferential surface.

9. A method for making a holder/optical-element assembly according to Claim 6, wherein the projected portion comprises a hemispherical section of the optical-element material.

10. A method for making a holder/optical-element assembly according to Claim 7, wherein the cylindrical holder further comprises an outer portion forming an outer circumferential surface of the cylindrical holder.

11. A method for making a holder/optical-element assembly according to Claim 10, wherein the outer portion comprises a metal selected from the group consisting of aluminum and stainless steel.

12. A method for making a holder/optical-element assembly according to Claim 1, wherein the holder material is characterized by a flow resistance and

the optical-element material is characterized by a viscosity, and wherein the flow resistance of the holder material varies inversely to the viscosity of the optical-element material.

13. A method for making a holder/optical-element assembly according to Claim 4, wherein the holder material is characterized by a flow resistance and the void part is characterized by a volume, and wherein the volume of the void part and the flow resistance of the holder material are adjusted to accommodate the extra amount of optical-element material in the void part.

14. A method for making a holder/optical-element assembly according to Claim 8, wherein the holder material is characterized by a flow resistance and the one or more concentric cavities are characterized by a width, and wherein the flow resistance of the holder material varies in proportion to the width of the one or more concentric cavities.

15. A method for making a holder/optical-element assembly according to Claim 1, wherein the softening temperature of the cylindrical holder material is higher than the softening temperature of the optical element material.

16. A method of Claim 15, wherein heating the cylindrical holder material and the optical-element material comprises heating to a temperature about 30 degrees lower than the softening temperature of the cylindrical holder material.

17. The method of Claim 15, wherein the softening temperature of the cylindrical holder material is about 30 degrees higher than the softening temperature of the optical-element material.

18. The method of Claim 1, further comprising:
wherein providing the cylindrical holder material, comprises
providing a material having a specified flow resistance;

wherein providing the optical-element material comprises providing a material having a viscosity, a glass transition temperature, and a glass softening temperature;

selecting a heating temperature between the glass transition temperature and the glass softening temperature; and

adjusting the flow resistance of the void part and a mold pressure during press-molding to accommodate projected portion.

19. The method of Claim 1, wherein heating the cylindrical holder material and the optical-element material comprises heating to a temperature between the glass transition and the glass softening temperature of the optical-element material.